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St Albans – Trials P2 2021 Memo

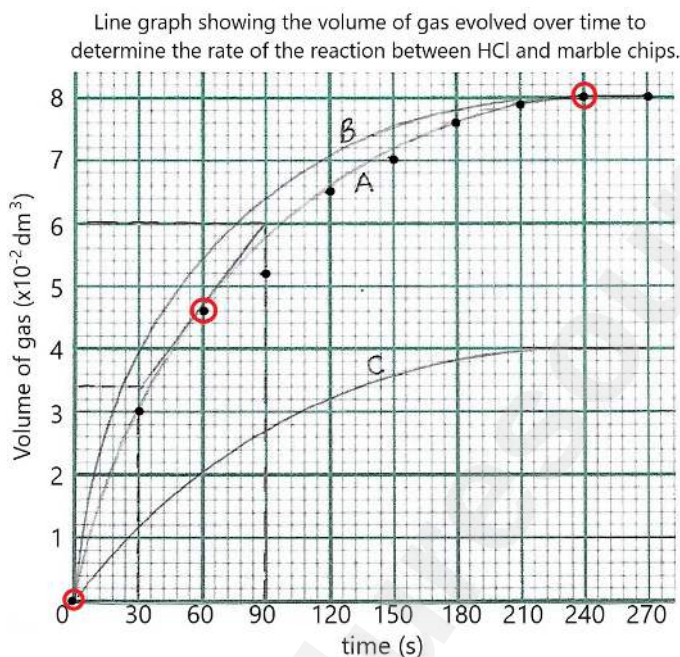
Question 1

- 1.1 C ✓✓ 1.6 D ✓✓
 1.2 B ✓✓ 1.7 B ✓✓
 1.3 D ✓✓ 1.8 A ✓✓
 1.4 C ✓✓ 1.9 C ✓✓
 1.5 A ✓✓ 1.10 B ✓✓

$$10 \times 2 = [20]$$

Question 2

- 2.1 Heading ✓
 y-axis label & unit ✓
 plotted points (select 2 to check) ✓✓
 line of best fit (label A) ✓
 values increasing evenly on y-axis ✓
 (6)



- 2.2 Reaction rate decreases. ✓ (1)

- 2.3 As the reaction proceeds..
 • Concentration of acid decreases OR
 Fewer particles of acid per unit volume ✓
 • Total surface area of marble decreases ✓
 • Less collisions per unit time, thus fewer effective collisions per unit time ✓
 (3)

- 2.4 Show tangent to the curve at 60 s, or
 ave gradient ✓

r.r = gradient of tangent

$$= \frac{(6 \times 10^{-2}) - (3,4 \times 10^{-2})}{90 - 30} \checkmark$$

$$= 4,33 \times 10^{-4} \text{ dm}^3 \cdot \text{s}^{-1} \checkmark (4)$$

- 2.5 Curve above A (faster reaction rate) ✓
 Ends at the same place as A ✓
 (label B) – if not labelled, no marks can be awarded. (2)

- 2.6 Curve below A (slower reaction rate) ✓
 Ends halfway between A and x-axis ✓
 (label C) – if not labelled, no marks can be awarded. (2)

[18]

Question 3

3.1.1

	CO	NO	CO ₂	N ₂
Reaction (mol ratio)	2	2	2	1
Initial	0,92	0,90	0	0
Change	-0,4 ✓	-0,4	+0,4 ✓	+0,2
Equilibrium	0,52	0,5	0,4	0,2 ✓
$c = \frac{n}{V}$ (mol.dm ⁻³)	$= \frac{0,52}{2} = 0,26$	$= \frac{0,5}{2} = 0,25$	$= \frac{0,4}{2} = 0,2$	$= \frac{0,2}{2} = 0,1$

$$K_c = \frac{[\text{CO}_2]^2 [\text{N}_2]}{[\text{CO}]^2 [\text{NO}]^2} \checkmark$$

$$= \frac{(0,2)^2 (0,1)}{(0,26)^2 (0,25)^2} \checkmark$$

$$= 0,95 \checkmark (7)$$

- 3.1.2 **Yield:** a measure of the extent of a reaction ✓, generally measured by comparing the amount of product against the amount of product that is possible. ✓ (2)

3.1.3 Low yield ✓ ($K_c < 1$) (1)

3.2.1 $c = \frac{m}{M.V}$ ✓

$0,5 = \frac{m}{(66).(2)}$ ✓ for 0.5 & 2

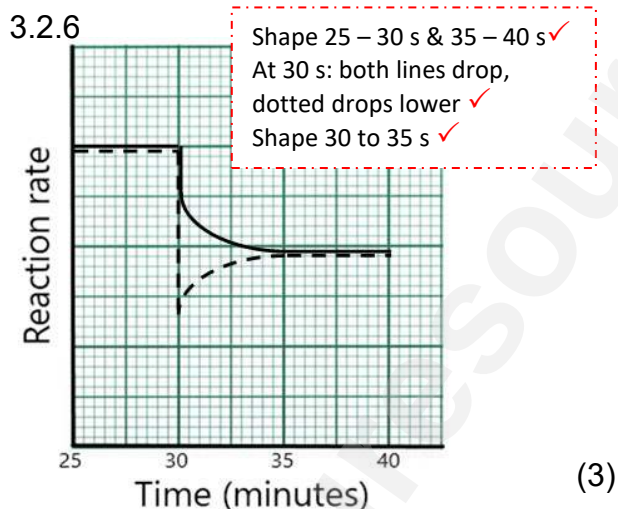
$m = 66 \text{ g}$ ✓ (4)

3.2.2 **Stress:** Decrease in $[CF_2]$ ✓ (1)

3.2.3 **Response:** According to L.C.P, fwd reaction is favoured ✓
Reason: To raise the $[CF_2]$ ✓
Observation: $[CO_2]$ & $[CF_2]$ increases & $[COF_2]$ decreases ✓ until a new equilibrium is reached ✓. (4)

3.2.4 Equal to ✓ (1)

3.2.5 Exothermic. ✓✓ (2)



3.2.7 All increase ✓✓ (2)

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Question 4

4.1 Hydrochloric acid ✓ (1)

4.2 A reaction of an ion (from a salt) with water ✓✓ (2)

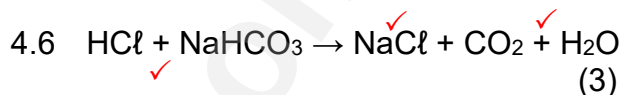
4.3 Na^+ , K^+ and Cl^- are ions of strong acids and bases ✓, and do not undergo hydrolysis ✓, and ∴

will no contribute to the pH of the gastric juice ✓ (3)

4.4 a solution of known concentration ✓✓ (2)

4.5 $c = \frac{m}{M.V}$
 $= \frac{20}{(84).(0,2)}$

$= 1,19 \text{ mol.dm}^{-3}$ ✓ (4)



4.7 an acid that only ionises partially in an aqueous solution ✓✓ (2)

4.8 Methyl Orange ✓
 This a reaction between a strong acid and weak base, ✓
 the pH at end point will be < 7 . ✓ (3)

4.9 $c = \frac{n}{V}$ ✓
 $= (0,155) \times (1)$ ✓
 $= 0,155 \text{ mol}$

∴ n of $NaHCO_3 = 0,155 \text{ mol}$ ✓

$c = \frac{n}{V}$
 $1,19 \text{ ca} = \frac{0,155}{V}$ ✓
 $V = 0,13025 \text{ dm}^3$ ✓
 $= 130,25 \text{ cm}^3$ ✓conversion (6)

4.10.1 B. ✓
 Average volume was $130,5 \text{ ml}$ ✓ (2)

4.10.2 B. ✓ (1)

4.11 The baking soda (base) will react completely with the stomach acid so that neither are in excess. ✓✓ (2)

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Question 5

5.1.1 $\text{Fe}(\text{NO}_3)_2$ ✓ (1)
any iron salt (except FeCl_2)

5.1.2 NaNO_3 ✓ (1)
any ionic salt

5.2 Cations are reduced at the cathode ✓
leaving NO_3^- (aq) in the solution. ✓
The positive ions flow towards
 NO_3^- ions to maintain electrical
neutrality. ✓
or
leaving excess negatively charged
ions in P ✓ so positive ions move in
to neutralize this charge. ✓ (3)

5.3 $E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$ ✓
1,22 = $E_{\text{cathode}} - (-1,66)$ ✓
 $E_{\text{cathode}} = -0,44 \text{ V}$ ✓



5.4.1 decrease ✓ (1)

5.4.2 remain the same ✓ (1)

5.5 $\text{Al}_{(\text{s})} / \text{Al}^{3+}_{(\text{aq})} // \text{Fe}^{2+}_{(\text{aq})} / \text{Fe}_{(\text{s})}$ ✓ ✓ (2)

[14]

Question 6

6.1 Electroplating ✓ (1)

6.2 An electrolyte as a substance that
can conduct electricity by forming
free ions when molten or dissolved
in solution. ✓ ✓ (2)

6.3.1 Cathode ✓ (1)

6.3.2 $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$ ✓ ✓ (2)

6.4 Any metal lower down than Ni
on the SEP table (that has a
higher oxidizing ability or lower
reducing ability). ✓

Even though both metals will
undergo oxidation at the anode,

**Ni will be more readily
oxidized** ✓

**as it will be the stronger
reducing agent.** ✓

Platinum...inert max 2/3

$$\begin{aligned} 6.5.1 \quad n &= \frac{m}{M} \checkmark \\ &= \frac{5,6}{59} \checkmark \\ &= 0,095 \text{ mol} \checkmark \end{aligned} \quad (3)$$

6.5.2 $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$
1 mol Ni : 2 mol e^- ✓

$$\begin{aligned} n(\text{e}^-) &= 2 \times 0,095 \\ &= 0,19 \text{ mol} \checkmark \end{aligned}$$

$$\begin{aligned} \frac{Q}{n.F} &= \frac{I.t}{I.t} \checkmark \\ (0,19).(96500) &= (1,2) \checkmark .t \\ t &= 15279,17 \text{ s} \checkmark \end{aligned}$$

Or

$$\begin{aligned} n &= \frac{N}{N_A} \\ 0,095 &= \frac{N}{6,02 \times 10^{23}} \checkmark \\ N &= 5,719 \times 10^{22} \end{aligned}$$

1 mol Ni : 2 mol e^- ✓

$$\begin{aligned} \text{Number of } \text{e}^- &= 5,719 \times 10^{22} \times 2 \\ &= 1,1438 \times 10^{23} \end{aligned}$$

$$\begin{aligned} Q &= \text{no of electrons} \times 1,6 \times 10^{-19} \\ &= 18300,8 \text{ C} \checkmark \end{aligned}$$

$$\begin{aligned} \frac{Q}{I} &= \frac{I.t}{I} \checkmark \\ 18300,8 &= (1,2) \checkmark .t \\ t &= 15250,67 \text{ s} \checkmark \end{aligned} \quad (6)$$

Note: if an unrounded number is used
from 5.5.1 (0,09491525), then the
correct time will be
= 15265,54 s (method 1) or
= 15237,062 s (method 2)

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Question 7

- 7.1 Al_2O_3 ✓✓ (2)
- 7.2 A transfer of electrons✓ and subsequent electrostatic attraction✓ (2)
- 7.2 Molten✓. Due to the presence of free (mobile) ions✓ (2)
- 7.4 The cryolite is used to lower the working temperature✓, thus providing a considerable saving on energy costs. ✓ (2)
- 7.5 electrical (potential) energy✓ to chemical (potential) energy✓ (2)
- 7.6 Metallic bonding✓
bonding between a positive kernel and a sea of delocalised electrons✓✓ (3)
- 7.7.1 The carbon anodes burn away✓ and have to be replaced regularly. ✓
OR
At high temps, graphite electrodes react with oxygen✓ to form CO_2 gas (greenhouse gas) ✓ (2)
- 7.7.2 $\text{Al}^{3+}_{(\text{aq})} + 3\text{e}^- \rightarrow \text{Al}_{(\text{l})}$ ✓✓ (2)
- 7.7.3 $4\text{Al}^{3+}_{(\text{aq})} + 6\text{O}^{2-}_{(\text{aq})} \rightarrow 4\text{Al}_{(\text{l})} + 3\text{O}_{2(\text{g})}$
✓LHS ✓RHS ✓balancing (3)

[20]

Question 8

- 8.1 weak force of attraction between molecules, ions, or atoms of noble gases. ✓✓ (2)
- 8.2 Butane has a HIGHER b.p. than butene because
- although they both have London forces between their molecules✓
 - Butane is a larger molecule with a greater surface area and it has more electrons / a greater electron cloud density✓
 - thus produces larger temporary dipoles ✓
 - thus it has stronger✓ London forces
 - resulting in more energy required to overcome the intermolecular forces✓ and separate the butane molecules. (5)
- 8.3.1 $\text{C}_2\text{H}_4\text{O}_2$ ✓✓ (2)
- 8.3.2 functional✓ isomers ✓ (2)
- 8.4.1
- $$\begin{array}{ccccccc} & & \text{H} & & \text{H} & & \\ & & | & & | & & \\ \text{H} & - & \text{O} & - & \text{C} & - & \text{C} & - & \text{O} & - & \text{H} \\ & & | & & | & & & & & & \\ & & \text{H} & & \text{H} & & & & & & \end{array}$$
- ✓✓ (2)
- 8.4.2 It can form two hydrogen bonds✓ between its molecules as opposed to the one✓ that it formed between propan-1-ol molecules. It also has a greater mass, 62 g.mol^{-1} , than propan-1-ol which has a mass of 60 g.mol^{-1} . ✓ Thus it can also form more temporary dipoles (London forces)✓ between its molecules due to it having more electrons ✓ Resulting in more energy required to overcome the accumulative strength of the intermolecular forces in ethane-1,2-diol. ✓ (6)

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Question 9

9.1 Thermal cracking ✓✓ (2)

9.2 A series of similar compounds which have the same functional group and have the same general formula, in which each member differs from the previous one by a single CH_2 unit. ✓✓ (2)

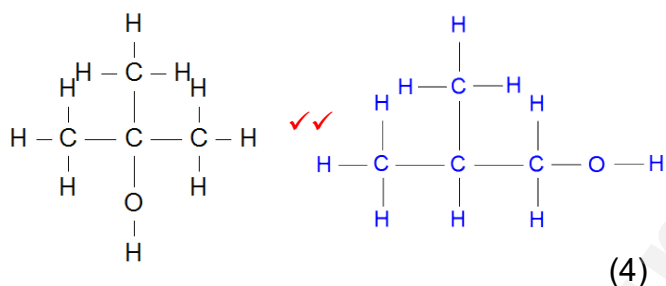
9.3 Alkenes ✓ (1)

9.4 Addition ✓ (1)

9.5 2-methylpropan-2-ol ✓✓

Or

2-methylpropan-1-ol



9.6.1 sulphuric acid ✓ (1)

9.6.2 water / H_2O ✓ (1)

9.7.1 halogen substitution ✓
Or
Hydrolysis (1)

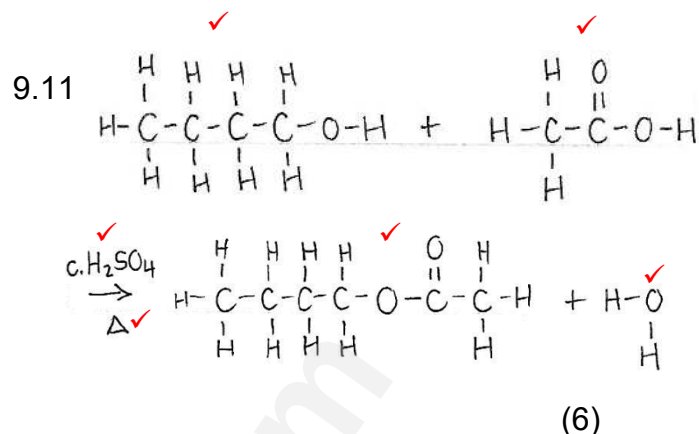
9.7.2 $\text{CH}_3(\text{CH}_2)_3\text{Br}$ ✓✓ (2)

9.7.3 $\text{C}_4\text{H}_9\text{Br} \rightarrow \text{C}_4\text{H}_8 + \text{HBr}$ ✓ ✓ ✓ ✓format (4)

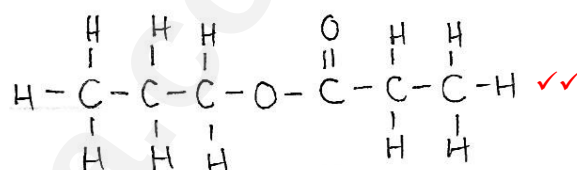
9.8 Condensation (Esterification) ✓ (1)

9.9 an atom or a group of atoms that form the centre of chemical activity in the molecule ✓✓ (2)

9.10 $\begin{array}{c} \text{O} \\ || \\ \text{---C---O---} \end{array}$ ✓✓ OR ESTER (2)

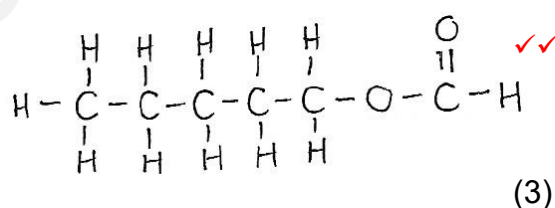


9.12 Propylpropanoate ✓



OR

Methylpentanoate ✓



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Examination total: 200 marks

WORLD DOMINATION
STARTS WITH CHEMISTRY

